Application for Experimental License

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I. Mission Summary

By this application, Hedron Space Inc. ("Hedron") (formerly Analytical Space, Inc.) seeks Federal Communications Commission ("FCC") authorization to conduct a demonstration satellite mission in support of the company's long-term goal of building an in-orbit data relay satellite network that will enable near real-time knowledge of the Earth's surface for Earth imaging systems by increasing average data offload rates and providing a continuous low-latency link for other satellite operators.[1] The Cornicen mission is Hedron's third satellite demonstration mission[2] and is partially funded by the Department of Defense, Department of the Air Force, Space and Missile Systems Center under contract number FA8808-20-C-0016 P00003.

The Cornicen mission will demonstrate a new type of satellite service. Through formation flying, Cornicen will serve as an in-orbit communications relay for a partner Maxar Legion satellite ("Maxar Satellite").[3] Cornicen will also demonstrate experimental hardware and software developed by Hedron and the MITRE Corporation ("MITRE"), involving the Frequency-scaled Ultra-wide Spectrum Element ("FUSE") payload and conduct tests of radiofrequency ("RF") sensing capabilities of signals having no communications content (*i.e.*, S-band radar) or for which MITRE is authorized to transmit. Hedron partners will each independently seek authority to transmit to Cornicen, as part of the experimental demonstrations.

Following these demonstrations, Cornicen will use the expected remaining propellant on board to lower its orbit altitude to below 400 km and then passively deorbit in approximately six months with no debris casualty risk.

II. Mission Phases

The Cornicen mission is comprised of four phases, as follows: (1) After release from the launch vehicle, Cornicen will navigate from its launch release orbit to its operational orbit. This transition is expected to take roughly 15 months, which includes precision navigation to commence formation flying with the Maxar Satellite. During this phase, Hedron and MITRE will conduct the joint testing discussed below with respect to the FUSE payload; (2) When Cornicen reaches its operational orbit, it will commence in-orbit relay testing for approximately 6 months; (3) When the relay testing is complete, Cornicen will disengage from formation flying with the Maxar Satellite and will continue its joint Hedron-MITRE testing of the FUSE payload for approximately 9 months; and (4) At end of mission, Cornicen will use the expected remaining propellant on board to lower its orbit altitude to below 400 km and then passively

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[1] Debra Werner, *Hedron, formerly Analytical Space, raises $17.8 million* (Oct. 26, 2021), https://spacenews.com/hedron-formerly-analytical-space-raises-17-8-million/.

[2] *See, e.g.*, Application, ELS File No. 0044-EX-ST-2017 (describing Radix mission); Application, ELS File No. 0306-EX-ST-2019 (describing Meshbed mission).

[3] Hedron will advise the FCC by letter when the specific Maxar satellite has been selected and launched.

deorbit in approximately six months. The expected mission lifetime is 30 months. The figure below summarizes the communications payloads to be used during each phase of the mission.

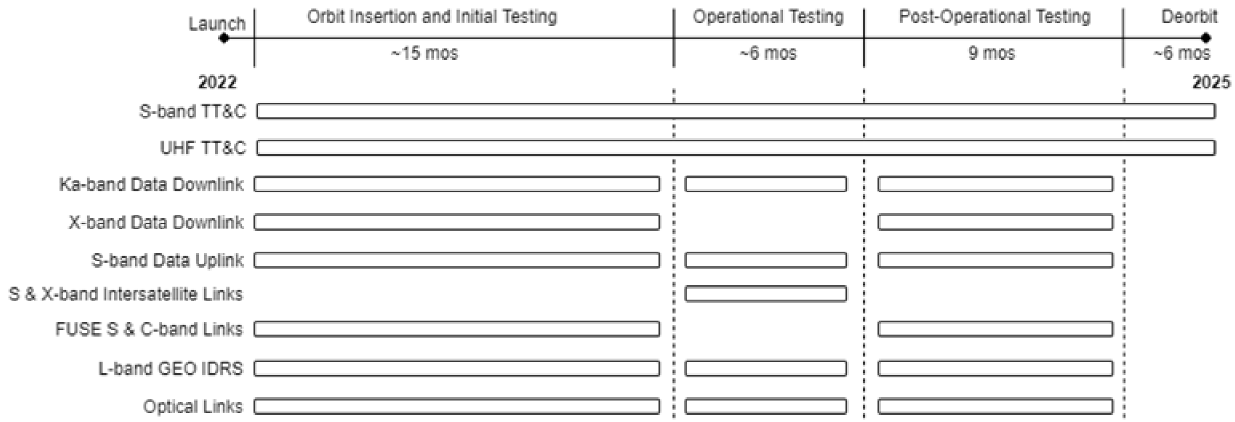

Figure 1. Cornicen Mission Phases and Communications Links

a. Orbit Insertion and Initial Testing

The Cornicen experimental spacecraft is expected to be launched on a SpaceX Falcon 9 rocket in October 2022 and inserted into a sun-synchronous orbit ("SSO") (*i.e.*, 98 degrees inclination ± 0.1 degrees) with a perigee and apogee of 550 km +/- 25 km, and a local time of the descending node ("LTDN") of 10:30 +30/-15 min. After post-launch check out, Cornicen will maneuver from its insertion orbit to its target operational 518 km circular orbit with an SSO inclination of 97.5 degrees, at LTDN 10:30 +/- 15 min, which will be a formation flying orbit with the partner Maxar Satellite. During this phase, Cornicen will at all times maintain a physical distance of approximately 50 to 100 km away from the partner satellite to ensure operational safety.

Depending on the launch deployment LTDN, Cornicen will either raise or lower orbital altitude as part of the orbital transition to the target operational orbit at 518 km in formation with the Maxar Satellite. In order to change the precession rate of Cornicen to efficiently transition toward the Maxar Satellite, the parameters to change are inclination and altitude. From a propulsion efficiency and propellant conservation perspective, altitude changes are much more efficient than inclination changes. Accordingly, if the insertion orbit deploys Cornicen at a higher LTDN than the partner Maxar Satellite, Cornicen will need to lower its LTDN by maneuvering *up in altitude*. However, if the insertion orbit is at a lower LTDN, Cornicen would simply need to maneuver *down in altitude*. In the first case, Hedron estimates based on simulations that the highest orbital altitude that Cornicen would maneuver to would be 645 km, based on a deployment LTDN of 11:00 and a target operational LTDN of 10:30. The attached ODAR shows that in the worst-case situation that Cornicen fails at 645 km, the satellite would nonetheless deorbit within the required 25-year period. A more detailed discussion of the transfer orbit path is discussed in the ODAR.

During the orbit insertion and initial testing phase, Cornicen will utilize its S-band telemetry, tracking and control ("TT&C") links, backup UHF TT&C links, Ka-band data downlink, X-band data downlink, S-band data uplink, FUSE S-band and C-band links, L-band intersatellite links ("ISLs"), and optical links, as shown in Figure 2 below.

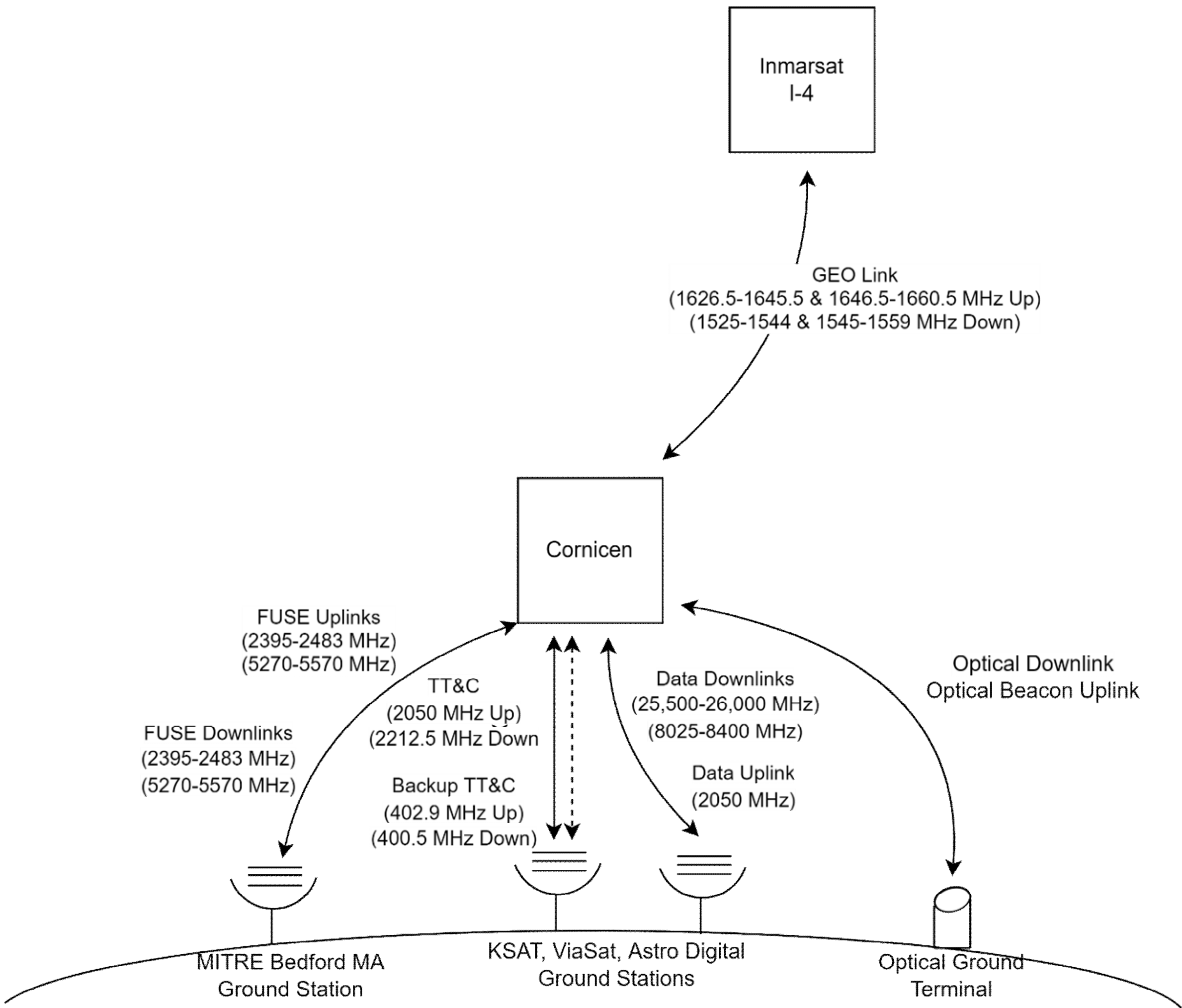

Figure 2. Orbit Insertion and Initial Testing

b. Operational Testing

Once Cornicen arrives at its operational orbit, the vehicle will formation fly with a Maxar Satellite and commence relay testing with the satellite for approximately 6 months. During the operational testing phase, Cornicen will utilize its S-band TT&C links, backup UHF TT&C

links, Ka-band data downlink, S-band data uplink, S-band and X-band intersatellite links, L-band ISLs, and optical links, as shown in Figure 3 below.

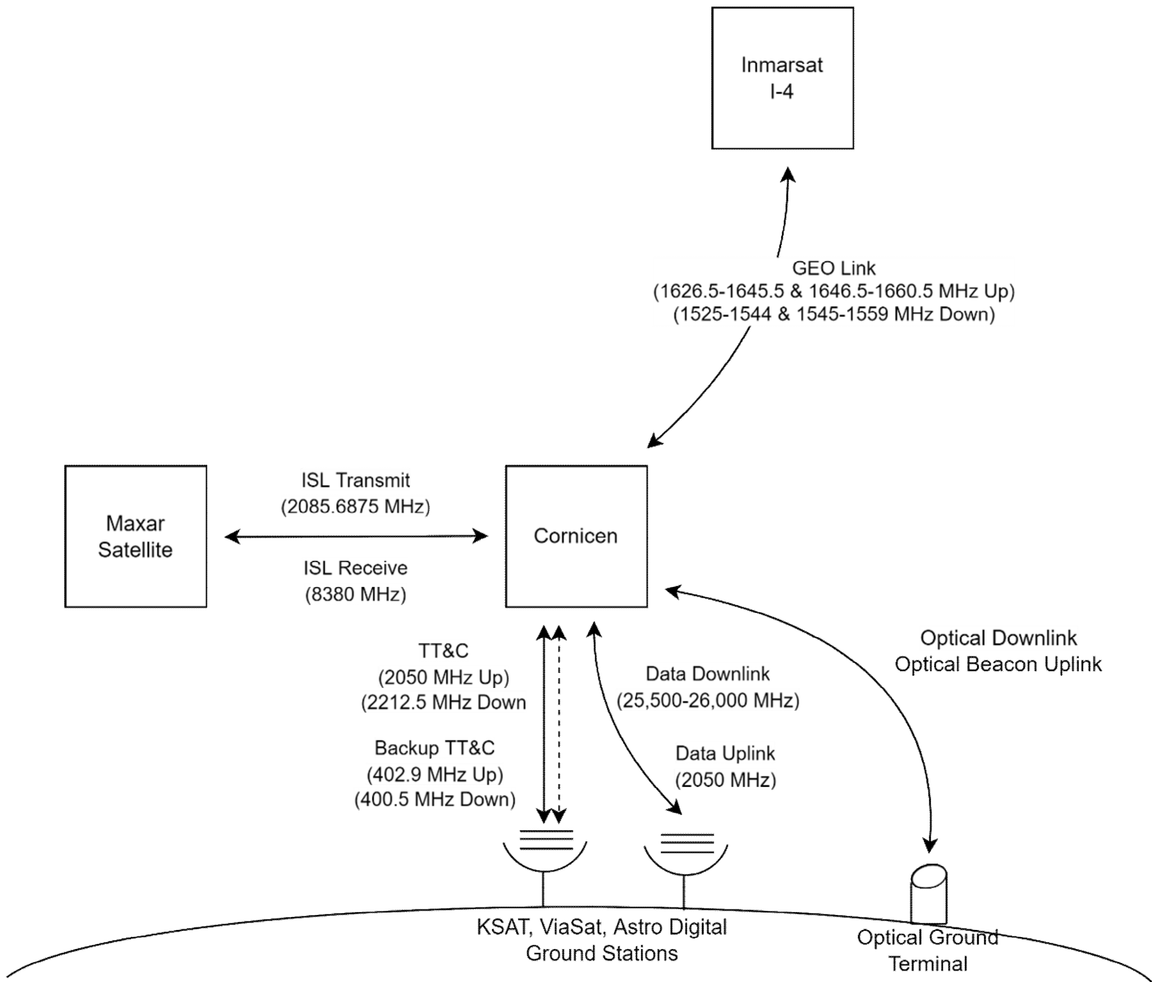

Figure 3. Operational Testing

c. Post-Operational Testing

Following relay demonstrations with the Maxar Satellite, Cornicen will disengage from formation flying to a distance of greater than 100 km away from the Maxar Satellite. Then, for approximately 9 months, Cornicen will use and continue testing the same mission payloads that were tested in the orbit insertion and initial testing phase, *i.e.*, S-band TT&C links, backup TT&C links, Ka-band data downlink, X-band data downlink, S-band data uplink, FUSE S-band and C-band links, L-band intersatellite links, and optical links, as shown in Figure 2 above.

d. Deorbit

After completion of testing, Cornicen will use the expected remaining propellant on board to lower its orbit altitude to below 400 km. During this phase, Cornicen will use only its S-band TT&C links and backup UHF TT&C links. Once Cornicen is below 400 km orbital altitude and runs out of propellant, Hedron will decommission the spacecraft, and it will passively deorbit in approximately six months.

The attached ODAR demonstrates that Cornicen meets the FCC's orbital debris requirements.[4]

III. Satellite Bus Subsystems

a. Guidance, Navigation and Control Subsystem

Attitude determination and control system includes two star trackers, three reaction wheels, three torque rods, a 3-axis magnetometer, a 3-axis inertial measurement unit, a global positioning system ("GPS") receiver, and six coarse sun sensors.

b. Command and Data Handling Subsystem

The Flight Computer ("FC") receives instructions from the ground station(s) via the dedicated S-Band TT&C Communications Subsystem or the L-band Intersatellite Data Relay System ("IDRS") payload. The FC issues commands to all other subsystems and payloads for operation of the satellite. Additionally, the FC collects telemetry from all subsystems and forwards that information to the ground station through the TT&C Communication Subsystem or IDRS payload.

c. Electrical Power Subsystem

A Customized Payload Interface Power Module ("PIM") will provide power conversion and peak power ≥ 160W to support the Cornicen mission. This module collects power from custom deployable solar panels. The solar array provides a peak power collection of ≥ 150W to provide a fully margined (20%) OAP ≥ 56W to the payload for all spacecraft missions.

d. Thermal Control Subsystem

The Cornicen spacecraft will utilize thermal control coatings, thermal sensors and heaters to ensure spacecraft subsystem temperatures are maintained with operational and storage ranges depending on mission Concept of Operations ("CONOPS").

e. Structure Subsystem

The structure for the spacecraft is custom made for this mission. It uses a 200 milli-inch thick spacecraft structure to provide substantial radiation (2x Design Margin) mitigation to internal components.

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[4] *See* Attachment A, Orbital Debris Assessment Report.

f. Propulsion Subsystem

The propulsion system on the satellite is a state-of-the-art Enpulsion Micro R3 IFMM1-001 system. It has no moving parts and uses non-toxic Indium as the propellant. There are no liquids or reactive propellant as well as no pressurized vessels.

IV. Communications Systems

The Cornicen spacecraft has four independent radio subsystems:

(1) a dedicated TT&C radio communicating in S-band frequencies with ground stations and associated TX/RX antennas;
(2) a dedicated TT&C radio communicating in UHF frequencies with ground stations and associated TX/RX antennas;
(3) multi-channel software defined radio ("SDR") connected to (i) a Ka-band TX antenna, (ii) associated X-band TX/RX antennas, (iii) a C-band and S-band FUSE TX/RX antenna to communicate with a MITRE ground station in Bedford, MA, (iv) an S-band RX antenna to receive data transmissions from ground stations, and (v) an S-band TX antenna to transmit to a Maxar Satellite in orbit; and
(4) an AddValue L-band intersatellite radio terminal and associated TX/RX antennas communicating with Inmarsat geostationary orbit ("GSO") satellites.

Provided below in Tables 1 to 4 are specific frequency bands and power levels to be used on the mission. Cornicen also has an optical transceiver that will be tested with a ground terminal located in Athens, Greece.

Beam Name	Lower Freq (MHz)	Upper Freq (MHz)	Bandwidth (MHz)	EIRP (dBW)
TT&C S-Band Downlink[5]	2212.0	2213.0	1	1
TT&C UHF Downlink	400.48	400.52	0.04	5.5
Ka-Band Data Downlink	25,500	26,000	500	24.5
X-Band Data Downlink	8025	8400	375	25.7
FUSE S-band Downlink	2395	2483	88	11.2
FUSE C-Band Downlink	5270	5570	300	19

Table 1. Space-to-Earth Transmission Parameters

[5] Hedron has the capability to use any frequency within the 2200-2290 MHz band. The specific channel selection is subject to coordination with Federal operators.

Beam Name	Lower Freq (MHz)	Upper Freq (MHz)	Bandwidth (MHz)
TT&C S-Band Uplink[6]	2049.5	2050.5	1
TT&C UHF Uplink	402.88	402.92	0.04
S-band Data Uplink[7]	2049.5	2050.5	1
FUSE S-band Uplink	2395	2483	88
FUSE C-Band Uplink	5270	5570	300

Table 2. Earth-to-Space Receive Parameters

Beam Name	Lower Freq (MHz)	Upper Freq (MHz)	Bandwidth (MHz)	EIRP (dBW)
S-Band (LEO to LEO)	2085.6555	2085.7195	0.064	20
L-Band 1 (LEO to GEO)	1626.5	1645.5	0.2	10.5
L-Band 2 (LEO to GEO)	1646.5	1660.5	0.2	10.5

Table 3. Space-to-Space Transmission Parameters

Beam Name	Lower Freq (MHz)	Upper Freq (MHz)	Bandwidth (MHz)
X-Band (LEO to LEO)	8379.968	8380.032	0.064
L-Band 1 (GEO to LEO)	1525	1544	0.2
L-Band 2 (GEO to LEO)	1545	1559	0.2

Table 4. Space-to-Space Receive Parameters

The following subsections describe the nominal operations of all transmission beams and analyzes their potential for causing interference to authorized radio operations. Beam patterns,

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[6] Hedron has the capability to use any frequency within the 2025-2110 MHz band. The specific channel selection is subject to coordination with Federal operators.
[7] *See supra* note 6.

transmit power, geographic and power flux density ("PFD") analyses are included. The resulting power signatures define the range of potential interference.

a. TT&C Communications Subsystem

The Cornicen spacecraft bus utilizes a dedicated TT&C radio to provide space-to-Earth and Earth-to-space communications. Radio communication with ground stations will initiate at elevation angles above 10 degrees. A list of the relevant ground stations is provided as Attachment B.

Direction	Frequency (MHz)	Bandwidth (MHz)	Max EIRP (dBW)	Modulation
space-to-Earth (Tx)	2212.5	1	1	BPSK
Earth-to-space (Rx)	2050	1	~	BPSK

Table 5a. TT&C Communications Parameters

The S-Band telemetry downlink does not comply with Section 5.115 of the Commission's Rules which requires the provision of a station identification. The Cornicen satellite downlink does not transmit the call sign at the end of the downlink transmission in either clear voice or Morse code, as the satellite does not have the ability to do so. Also, the satellite maximizes the full duration of the downlink communication time for mission critical space operations telemetry. Hedron acknowledges the intent of the rule for station identification as a means of allowing others to trace unwanted interference, and assumes that the frequency coordination process will accomplish the same purpose in this regard. As such, Hedron respectfully requests a waiver for Section 5.115 of the Commission's Rules.

For redundancy purposes, the Cornicen spacecraft will also have backup TT&C radio operating in the UHF frequencies. The UHF frequency bands will be used only as a backup to the S-band TT&C links. Back-up TT&C communications will only be used in the event of the inability to use the primary TT&C link in the S-band frequencies, such as when the satellite is tumbling, and for occasional testing to ensure the operational capability of the back-up TT&C system.

Direction	Frequency (MHz)	Bandwidth (MHz)	Max EIRP (dBW)	Modulation
space-to-Earth (Tx)	400.5	0.04	5.5 dBW	GFSK
Earth-to-space (Rx)	402.9	0.04	~	GFSK

Table 5b. Backup TT&C Communications Parameters

i. 400.48-400.52 MHz (space-to-Earth)

The 400.15-401 MHz (space-to-Earth) band is allocated internationally and in the U.S for federal and non-federal mobile-satellite and space research use on a primary basis as well as for federal and non-federal space operation use on a secondary basis.[8] Cornicen's use of the spectrum for space operations is therefore consistent with the U.S. and International Table of Frequency Allocations. Hedron will complete coordination with Federal operators for use of these frequencies as required.

Hedron is aware that the FCC established an October 15, 2019 cut-off deadline for requests to operate, *inter alia*, in the 400.15-401 MHz band for the provision of Mobile-Satellite Service.[9] Hedron proposes to use this band for Space Operations on a secondary basis, consistent with the U.S. Table of Frequency Allocations, and its limited use of the band for TT&C is not mutually exclusive with other operations on a long-term basis. Accordingly, the request to use these frequencies should not be treated as inconsistent with the 400.15-401 MHz processing round.

ii. 402.88-402.92 (Earth-to-space)

The 402-403 MHz band is allocated internationally and in the U.S for Earth exploration-satellite service ("EESS") (Earth-to-space) use on a primary basis for federal users and on a secondary basis for non-federal users, limited to earth stations transmitting to Federal space stations.[10] Because the Cornicen test mission will be used primarily in support of an EESS satellite, Cornicen's use of the spectrum should be treated as an EESS use of the spectrum, and accordingly Hedron's use of this band is consistent with the International Table of Frequency Allocations. As discussed above, Hedron will use these frequencies only for LEOP and backup TT&C (command) purposes and will operate on a non-harmful interference basis. To ensure compatibility with federal radiosonde systems, earth stations would not transmit RF signals during radiosonde synoptic hour (0:00 UTC and 12:00 UTC; synoptic hour typically indicates a 120-minute period of the radiosonde flight time) and will avoid pointing their uplink antennas main beam within a 30 degree horizontal sector in the direction of any radiosonde receiver ground station locations that are within 150 kilometers from the earth station during radiosonde flights.[11]

iii. 2025-2110 MHz (Earth-to-space)

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[8] The 400.15-401 MHz band is also allocated to meteorological aids and meteorological-satellite service and to the space research service in the space-to-space direction for communications with manned space vehicles.

[9] *See Cut-off Established for Additional NVNG MSS Applications or Petitions for Operations in the 399.9-400.05 MHz and 400.15-401 MHz Bands*, Public Notice, DA 19-779 (rel. Aug. 15, 2019).

[10] *See* 47 C.F.R. § 2.106 n.US384. The 402-403 MHz band is also allocated to meteorological aids and meteorological-satellite service.

[11] *See* Stamp Grant, Astro Digital, IBFS File No. SAT-MOD-20210319-00036, at Condition 12 (granted May 28, 2021). Astro Digital is providing ground station and operational support for the mission.

The 2025-2110 MHz (Earth-to-space) band is allocated internationally and in the U.S. for EESS and space research for non-Federal use, subject to conditions as may be applied on a case-by-case basis and the limitation that any use may not cause harmful interference to authorized Federal and non-Federal operations.[12] As discussed above, because the Cornicen test mission will be used primarily in support of an EESS satellite, Cornicen's use of the spectrum should be treated as an EESS use of the spectrum and consistent with the U.S. and International Table of Frequency Allocations.

Moreover, use of this band can and will be coordinated ensuring that operations will not cause harmful interference. Sharing of spectrum will be possible because Cornicen and other satellites using these frequencies transmit and receive only in short periods of time while visible to a receiving/transmitting earth station main beam. For harmful interference to occur, satellites belonging to different systems would have to be visible to the earth station and transmitting or receiving using the same frequencies at the exact same time. In such an unlikely event, the resulting inline interference could be avoided by coordinating the satellite transmissions so that they do not occur simultaneously. Accordingly, there is no mutual exclusivity between Cornicen and other non-geostationary satellite ("NGSO") systems using the same frequency band. Hedron will also comply with technical requirements in Part 2 of the Commission's rules and applicable ITU rules and complete coordination with Federal operators as required.

iv. 2200-2290 MHz (space-to-Earth)

The 2200-2290 MHz band (space-to-Earth) is allocated internationally for EESS, space research, and space operations.[13] Hedron will transmit on these frequencies only to non-U.S. ground stations. As discussed above, Cornicen should be treated as an EESS system, and accordingly Hedron's use of this band is consistent with the International Table of Frequency Allocations. Moreover, as explained above, shared use of these frequencies can be readily accomplished and will be coordinated with other operators ensuring that operations will not cause harmful interference.[14]

Power Flux Density at the Surface of the Earth in the band 2200 - 2290 MHz

ITU Radio Regulations Table 21-4 limits the power flux density of transmission over a 4 kHz bandwidth between 2200-2900 MHz to the following limits.

- -154 dB(W/m^2) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane.

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[12] *See* 47 C.F.R. § 2.106 n.US347. The 2025-2110 MHz (Earth-to-space) band is also allocated to space operations internationally. 47 C.F.R. § 2.106.
[13] *See* 47 C.F.R. § 2.106. In the United States, this band is allocated primarily for Federal EESS, space research, and space operations.
[14] *See* discussion *supra* page 10.

- $-154 + 0.5 * (\theta - 5)$ dB(W/m^2) in any 4 kHz band for angles of arrival, θ (in degrees) between 5 and 25 degrees above the horizontal plane.
- -144 dB(W/m^2) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

PFD is calculated as follows.

- PFD [dB(W/m^2 / 4 kHz] = EIRP (dBW) – 71 – 20log10(D) – 10log10(BW) – 24, where EIRP is the Maximum EIRP of the transmission; D is the distance between the satellite and affected surface area in km; and BW is the bandwidth of the transmission in MHz.

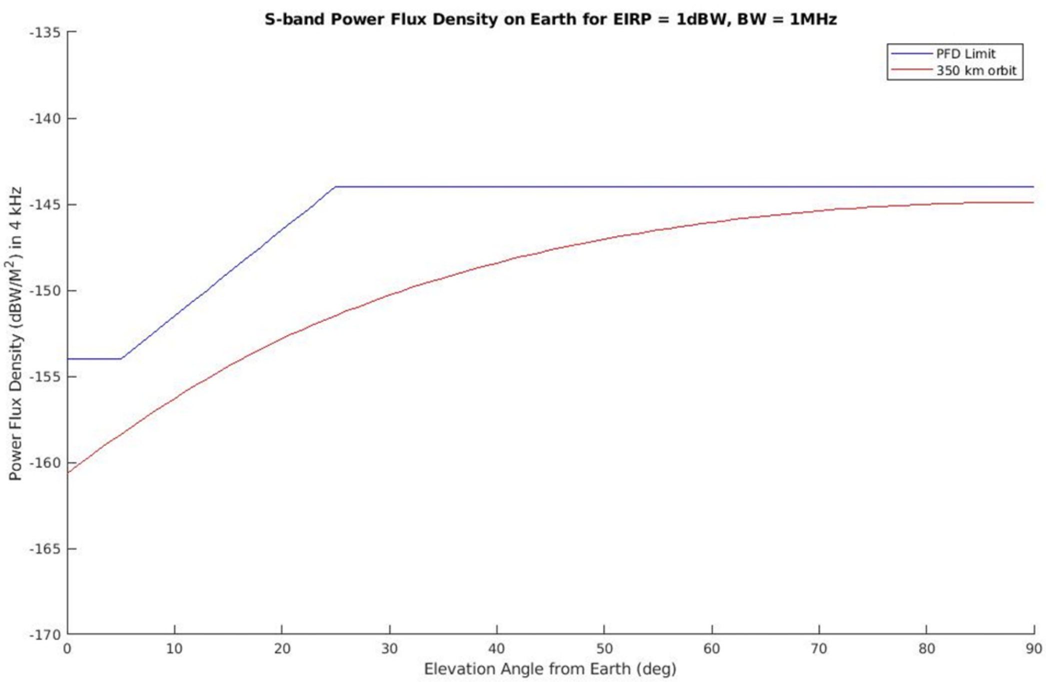

Figure 4. S-band Power Flux Density

Cornicen is expected to have a worst-case operational orbit altitude of 350 km during its mission lifetime. The figure above shows the maximum power flux density with respect to elevation angle at the worst case.

Sharing with other NGSO EESS Systems

Hedron will coordinate with authorized Federal and non-Federal operators to ensure Hedron's operations do not cause harmful interference. *See* the discussion in Section IV.a.iii.

b. Other Communications Subsystem

Cornicen utilizes a multi-channel software-defined radio ("SDR") to communicate across frequency bands and waveforms, constrained by the capabilities of the associated antenna hardware.

This radio will transmit payload data space-to-Earth in Ka-band (25.5-26 GHz) and X-band (8025-8400 MHz) frequencies to identified ground station providers. Additionally, the SDR will transmit space-to-Earth in the C-band (5270-5570 MHz) and S-band (2395-2483 MHz) frequencies to test a novel electronically steered phased-array antenna developed by the MITRE Corporation. Lastly, it will transmit space-to-space in the S-band frequencies (2085.6555-2085.7195 MHz) to a co-orbiting Maxar Satellite. The operation and interference analysis for each of these transmissions is described in more detail in the following sections.

i. 25.5-26.0 GHz (space-to-Earth)

The software-defined radio and associated antenna are used to transmit payload data to identified ground stations. *See* Attachment B. Transmissions will occur when Cornicen is within line of sight of a target ground station with an elevation angle of 10 or more degrees. On future missions, Hedron may request FCC authority to conduct intersatellite link transmissions using these frequencies.

Direction	Frequency (GHz)	Bandwidth (MHz)	Max EIRP (dBW)	Modulation
space-to-Earth (Tx)	25.5-26	500	24.5	QPSK

Table 6. Ka-band Data Downlink Communications Parameters

Frequency Band Allocation

The 25.5-27 GHz (space-to-Earth) band is allocated internationally and in the U.S. for EESS and space research on a primary basis for non-Federal use, subject to conditions as may be applied on a case-by-case basis.[15] As described above, Hedron's proposed services should be treated as EESS, and use of this band can and will be coordinated ensuring that operations will not cause harmful interference.[16] Accordingly, Cornicen may use this frequency band consistent with the U.S. and International Table of Frequency Allocations.

Power Flux Density at the Surface of the Earth in the band 25.5 - 27 GHz

[15] *See* 47 C.F.R. § 2.106 n.US258.

[16] *See* discussion *supra* page 10.

The FCC rules[17] and ITU Radio Regulations Table 21-4 limits the power flux density of transmission over a 1 MHz bandwidth between 25.5-27 GHz to the following limits dBW / m^2.[18]

- -115 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane.
- -115 + 0.5 * (θ - 5) dB(W/m^2) in any 1 MHz band for angles of arrival, θ (in degrees) between 5 and 25 degrees above the horizontal plane.
- -105 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

PFD is calculated as follows.

- PFD [dB(W/m^2 / 1 MHz] = EIRP (dBW) – 71 – 20log10(D) – 10log10(BW), where EIRP is the Maximum EIRP of the transmission; D is the distance between the satellite and affected surface area in km; and BW is the bandwidth of the transmission in MHz.

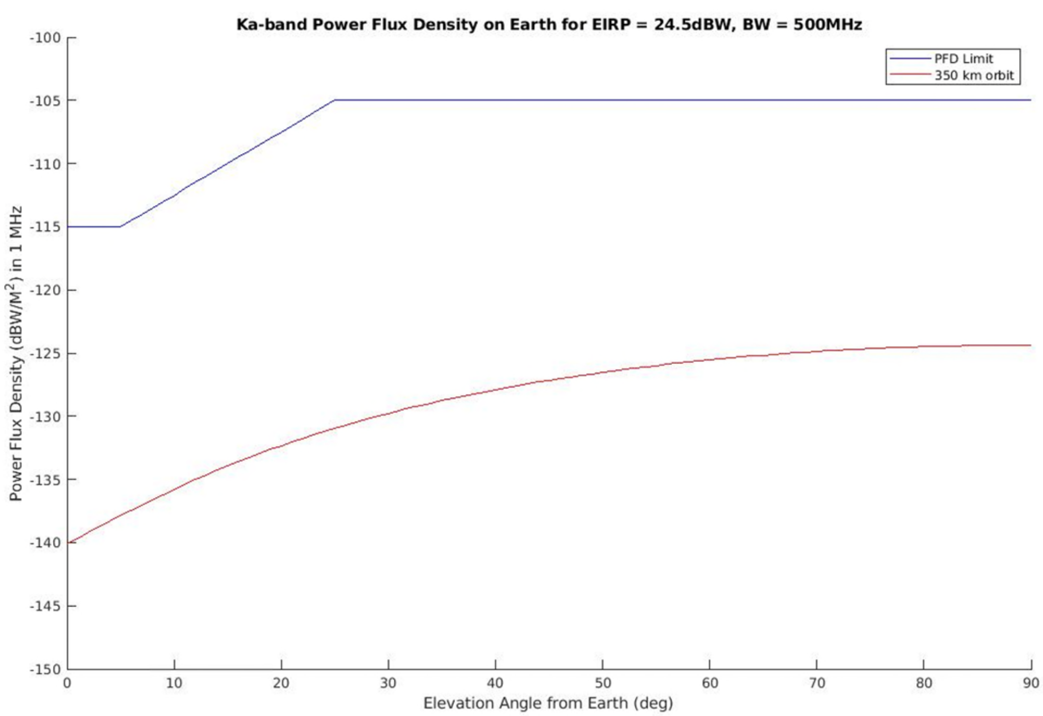

Figure 5. Ka-band Flux Density

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[17] *See* 47 C.F.R. § 2.106 n.US258 (providing that EESS authorizations for non-Federal use are subject to a case-by-case electromagnetic compatibility analysis).
[18] *See* ITU RR Art. 21; 47 CFR § 25.114(c)(8); 47 CFR § 25.208(p).

Cornicen is expected to have a worst-case operational orbit altitude of 350 km during its mission lifetime. This figure above shows the maximum power flux density with respect to elevation angle at the worst case.

Power Flux Density at the Geostationary Satellite Orbit

ITU Recommendation SA.1862 provides that EESS and SRS satellites in non-geostationary orbits with space-to-Earth satellite links should not produce a PFD greater than −133 dB(W/(m^2 · MHz)) at any data relay satellite location on the geostationary orbit.[19]

The Ka-band EESS PFD at the GSO produced by the Cornicen transmission is:

- PFD [dB(W/m^2 /MHz)] = EIRP (dBW) - 71 - 20log10(D) - 10log10(BW),

where:

- Effective Isotropic Radiated Power ("EIRP") is the Maximum EIRP of the transmission, in dBW;
- D is distance between Cornicen and GSO, in km; and
- BW is the bandwidth of the transmission, in MHz.

The minimum possible distance between Cornicen and the GSO is 35786 - 645 = 35141 km for the highest possible Cornicen orbit of 645 km.[20] Under a hypothetical assumption that the Cornicen antenna is radiating at its peak EIRP directly toward the GSO, the data downlink transmission with the peak EIRP = 24.5 dBW and BW = 500 MHz produces a PFD at the GSO of -164.4 dB(W/m^2) in any 1 MHz band. This PFD level is over 30 dB below the protection criteria defined in ITU-R SA.1862.

Sharing with other Systems

As explained above, shared use of these frequencies can be readily accomplished and will be coordinated with other operators ensuring that operations will not cause harmful interference.[21]

ii. 8025-8400 MHz Data Downlink (space-to-Earth)

The software-defined radio and associated antenna are used to transmit payload data to identified ground stations. *See* Attachment B. The transmission will occur while within line of sight of those ground station locations when above elevation angles of 10 degrees. In the future, Hedron may request FCC authority to use this radio link as an intersatellite link.

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[19] *See* ITU-R SA.1862 (recommends "5") 47 C.F.R. § 2.106 n.5.536A.

[20] As discussed above, in certain situations depending on the deployment orbit LTDN, Cornicen may need to first raise its altitude to 645 km before lowering it to 518 km. *See* discussion *supra* section II.a.

[21] *See* discussion *supra* page 10.

Direction	Frequency (MHz)	Bandwidth (MHz)	Max EIRP (dBW)	Modulation
space-to-Earth (Tx)	8025-8400	375	25.7	QPSK

Table 7. X-Band Data Downlink Communications Parameters

<u>Frequency Band Allocation</u>

The 8025-8400 MHz (space-to-Earth) band is allocated internationally and in the U.S. for EESS on a primary basis for non-Federal use, subject to conditions as may be applied on a case-by-case basis.[22] As described above, Hedron's proposed services should be treated as EESS, and use of this band can and will be coordinated ensuring that operations will not cause harmful interference.[23] Accordingly, Cornicen may use this frequency band consistent with the U.S. and International Table of Frequency Allocations.

<u>Power Flux Density at the Surface of the Earth in the band 8025-8400 MHz</u>

47 C.F.R. § 25.208 does not contain limits on power flux density at the Earth's surface produced by emissions from NGSO EESS space stations operating in the 8025-8400 MHz band. However, table 21-4 of the ITU Radio Regulations states that the power flux density at the Earth's surface produced by emissions from an EESS space station in the 8025-8400 MHz band, for all conditions and methods of modulation, shall not exceed the following values.

- -150 dB(W/m^2) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane.
- -150 + 0.5 * (θ - 5) dB(W/m^2) in any 4 kHz band for angles of arrival, θ (in degrees) between 5 and 25 degrees above the horizontal plane.
- -140 dB(W/m^2) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

PFD is calculated as follows.

- PFD [dB(W/m / 4 kHz] = EIRP (dBW) – 71 – 20log10(D) – 10log10(BW) – 24, where EIRP is the maximum EIRP of the transmission; D is the distance between the satellite and affected surface area in km; and BW is the bandwidth of the transmission in MHz.

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[22] *See* 47 C.F.R. § 2.106 n.US258.

[23] *See* discussion *supra* page 10.

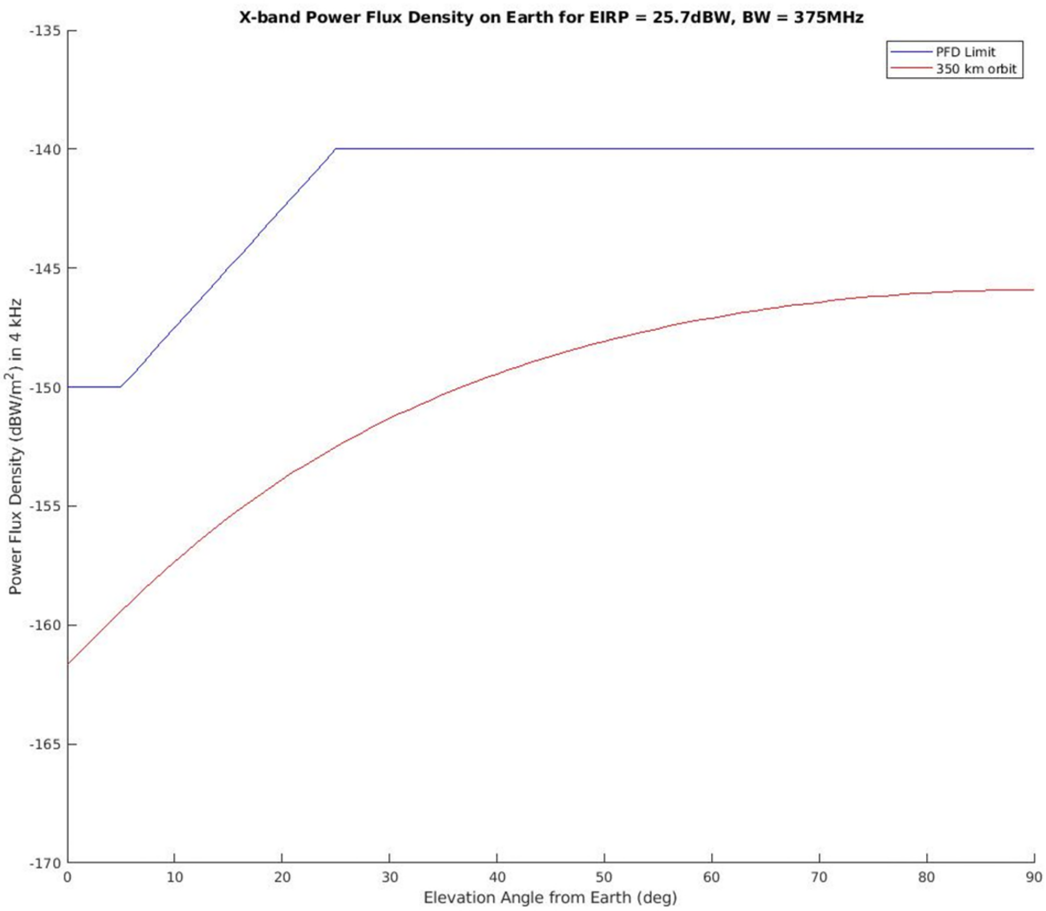

Figure 6. X-band Power Flux Density

Cornicen is expected to have a worst-case orbit altitude of 350 km during its mission lifetime. This figure shows the maximum power flux density with respect to elevation angle at the worst case.

Power Flux Density at the Surface of the Earth in the band 8400-8450 MHz

ITU-R Recommendation SA-1157 specifies a maximum allowable interference power spectral flux-density level at the Earth's surface of -255.1 dB(W/(m²*Hz)) to protect ground receivers in the deep-space research band 8400-8450 MHz. Cornicen uses a combination of digital filtering at the baseband signal (40 tap, root-raised cosine filters with a roll-off factor of 0.35), an 8th order analog bandpass IF filter, and bandpass RF filtering at the output of the transmitter to achieve the ITU recommended protection level for the 8400-8450 MHz band.

Power Flux Density at the Geostationary Satellite Orbit

ITU Radio Regulation No. 22.5 specifies that in the frequency band 8025-8400 MHz, which the EESS using non-geostationary satellites shares with the fixed-satellite service (Earth-to-space) or the meteorological-satellite service (Earth-to-space), the maximum PFD produced at the geostationary satellite orbit by any EESS space station shall not exceed –174 dB(W/m2) in any 4 kHz band. The calculation below shows that the PFD produced by the transmissions from Cornicen does not exceed the limit in No. 22.5, even in the worst possible hypothetical case.

The PFD at the GSO produced by the Cornicen transmission is:

- PFD [dB(W/m^2 /4 kHz)] = EIRP (dBW) - 71 - 20log10(D) - 10log10(BW) - 24,

where:

- Effective Isotropic Radiated Power (“EIRP”) is the Maximum EIRP of the transmission, in dBW;
- D is distance between Cornicen and GSO, in km; and
- BW is the bandwidth of the transmission, in MHz.

The minimum possible distance between Cornicen and the GSO is 35786 - 645 = 35141 km for the highest possible Cornicen orbit of 645 km.[24] Under a hypothetical assumption that the Cornicen antenna is radiating at its peak EIRP directly toward the GSO, the data downlink transmission with the peak EIRP = 26.0 dBW and BW = 375 MHz produces a PFD at the GSO of -185.66 dB(W/m^2) in any 4 kHz band.

Sharing with other non-Federal EESS Systems

As explained above, shared use of these frequencies can be readily accomplished and will be coordinated with other operators ensuring that operations will not cause harmful interference.[25]

V. FUSE Payload Communication Experiment[26]

MITRE and Hedron are conducting on-orbit and ground-based testing of an experimental, ultra-wideband RF payload that supports both transmit and receive capabilities between 1.5 GHz and 6.0 GHz. The communication experiment will test the payload’s ability to support frequency agile, two-way communications between an earth station located at the MITRE campus in Bedford, MA and the Cornicen experimental satellite. Hedron is seeking FCC experimental authorization for the satellite component of the experiment, and MITRE will separately seek

[24] As discussed above, in certain situations depending on the deployment orbit LTDN, Cornicen may need to first raise its altitude to 645 km before lowering it to 518 km. *See* discussion *supra* section II.a.
[25] *See* discussion *supra* page 10.
[26] MITRE Content Approved for Public Release: Case Number 22-0146. Distribution Unlimited. © 2022 The MITRE Corporation.

experimental authorization for the ground station component. Attached as an exhibit to this application is a letter of support from MITRE urging grant of the instant application.

The objectives of the experiment include: 1) demonstrating the ability to rapidly switch between frequency bands and change the instantaneous bandwidth of operation; and 2) quantifying communication data throughput and error rates at different frequencies and instantaneous bandwidths. The data being transferred will be randomly generated test data, except as discussed below with respect to the data collected by the FUSE Payload Sensing Experiment (see Section VI).

These tests involve both uplink and downlink transmissions in the following frequency bands: 2395-2483 MHz; and 5270-5570 MHz. The specific frequency bands were chosen solely based on deconfliction with existing spectrum usage. The use of these frequency bands is for experimental purposes only, and there are no plans to use these frequencies for long-term operations in the future.

The 5270-5570 MHz frequency band is allocated for federal and non-federal earth exploration satellite service (active), space research (active), radiolocation, and radionavigation services. With respect to the 2395-2483 MHz band, the vast majority of the band (2400-2483.5 MHz) is used largely for unlicensed operations. Different portions of the S-band frequencies are allocated for other uses, such as non-federal amateur, fixed, mobile and radiolocation services, and federal radiolocation service. Hedron will operate its tests on an unprotected, and non-harmful interference basis.

The communications operations will be limited to 5-10 minute intervals, 1-2 times per day in each case only when the Cornicen satellite is within line of sight of the MITRE Bedford ground station and greater than 20 degrees above the horizon. The limited and brief transmission periods, the high elevation above the ground at the MITRE ground station antenna site, the low power of the satellite transmissions, and the gain of the terrestrial antenna all will serve to mitigate potential interference to authorized operators in the test frequency bands.[27] Additionally, Hedron intends to engage with federal operators to coordinate the testing.

VI. FUSE Payload Sensing Experiment[28]

Through the same experimental payload, the Cornicen flight will facilitate on-orbit testing to assess the payload's ability to detect and to estimate the location of (*i.e.*, sense) RF emitters on or

[27] In addition, MITRE will conduct testing near the ground station site to ensure that uplink operations in the S-band frequencies do not interfere with nearby Wi-Fi systems or other terrestrial services.

[28]

near the earth's surface transmitting in the 1.5 – 6.0 GHz range.[29] Neither Hedron nor MITRE will decrypt, demodulate, or decode the underlying data (if any) being sensed.

The satellite payload is capable of sensing all frequencies within the 1.5 GHz and 6.0 GHz range, but will focus on the following signals of interest:

S-band marine radar	3020 - 3080 MHz
MITRE owned and operated earth station (located at the MITRE campus in Bedford, MA):[30]	2395 - 2483 MHz 5270 - 5570 MHz (as referenced in the FUSE Payload Communication Experiment Section)
MITRE owned and operated C-band test radar (located at the MITRE campus in Bedford, MA):[31]	5.645 - 5.655 GHz 5.695 - 5.705 GHz 5.720 - 5.730 GHz 5.745 - 5.755 GHz

VII. TT&C Intersatellite Link (Space-to-Space)

One of the primary goals of the Cornicen mission is to demonstrate an in-orbit intersatellite link that minimizes the operational burden on the partner Maxar Satellite.[32] Specifically, the Maxar Satellite TT&C radio and antennas will maintain a traditional nadir facing orientation and will communicate through antenna beam sidelobes to Cornicen, while formation flying at the same altitude, 518 km, and orbital plane. Cornicen's antennas are positioned on the ram face of the satellite such that theta = 90 is in the nadir direction. Cornicen will transmit tracking and command data in S-band (2085.6875 MHz) and receive telemetry data in X-band (8380 MHz). Cornicen will relay the Maxar Satellite data through its L-band IDRS radio or its software defined radio to the ground.

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[29] The FUSE sensing payload will be on board the Cornicen satellite. Hedron will conduct the sensing and relay the relevant data to MITRE, which will conduct the detection and location analysis.

[30] The earth station will be licensed under a future experimental license submitted by the MITRE Corporation.

[31] The MITRE C-band test radar was previously licensed under experimental license grant number: 0448-EX-CR-2019. This license expired 9/1/2020. Prior to the sensing experimentation, MITRE will apply for a similar experimental license for operations of the test radar.

[32] *See* Attachment D, Maxar Letter of Support.

To minimize potential interference to other satellites and ground operators, communication between Cornicen and the Maxar Satellite will be scheduled for times/locations where the Cornicen satellite is either not within Line of Sight (LoS) or is not in an orientation that could cause unacceptable levels of interference to other co-frequency NGSO satellites while they are within LoS of a serving Gateway Earth Station. Similarly, for NGSO satellites that receive co-frequency TT&C communications from a DRS satellite (such as TDRSS), S-band ISL emissions will be scheduled for times/locations where the Cornicen satellite is either not within LoS or is not in an orientation that could cause unacceptable levels of interference to another satellite operator. The interference analyses of Cornicen's transmissions are provided below.

Direction	Frequency (MHz)	Bandwidth (MHz)	Max EIRP (dBW)	Modulation
space-to-space (Tx)	2085.6875	0.064	20	BPSK
space-to-space (Rx)	8380	0.064	~	BPSK

Table 8. TT&C ISL Communications Parameters

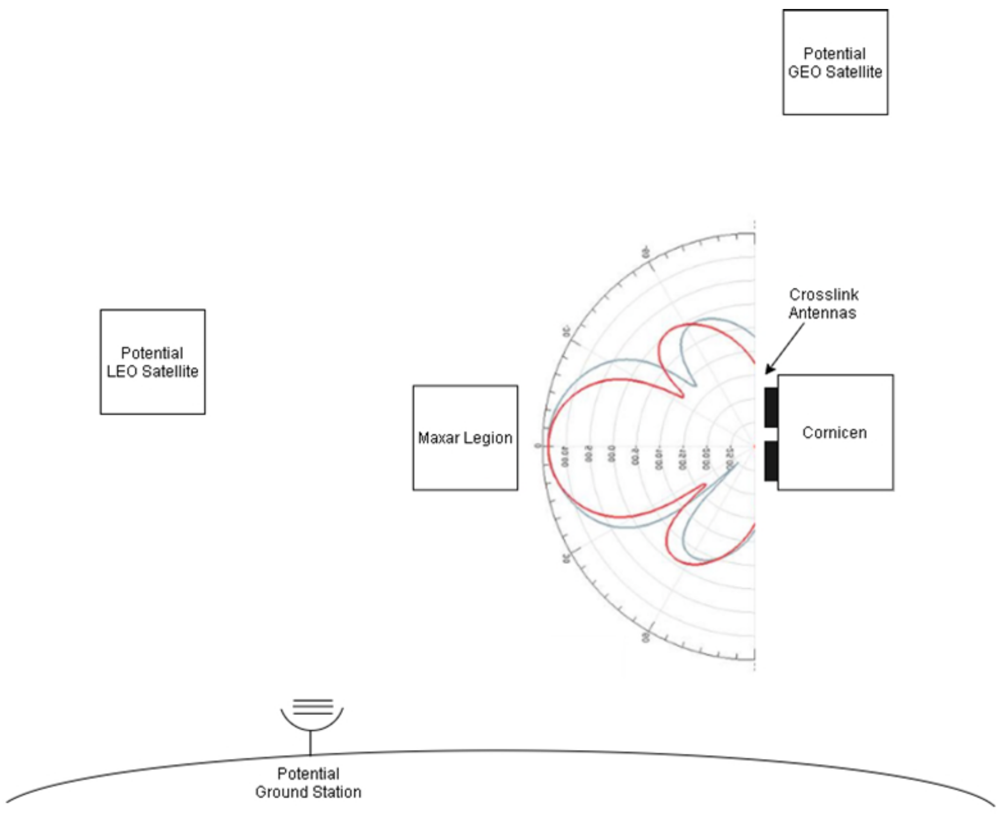

Figure 7. Interference Analysis

Frequency Band Allocation

i. 8215-8400 MHz (space-to-space)

There is no allocation for the 8215-8400 MHz band in the space-to-space direction (*i.e.*, Maxar Satellite to Cornicen). Hedron would use these frequencies on an unprotected and non-harmful interference basis. Through the operational measures identified in this section, Hedron expects that its use of these frequencies will not cause harmful interference to authorized users.

ii. 2025-2110 MHz (space-to-space)

The 2025-2110 MHz (space-to-space) band (*i.e.*, Cornicen to Maxar Satellite) is allocated internationally and in the U.S. for EESS and space research for non-Federal use, subject to conditions as may be applied on a case-by-case basis and the limitation that any use may not cause harmful interference to authorized Federal and non-Federal operations.[33] As described above, Hedron's proposed services should be treated as EESS, and accordingly, the proposed use is consistent with the U.S. and International Table of Frequency Allocations. Moreover, through the operational measures identified in this section, Hedron expects that its use of these frequencies will not cause harmful interference to authorized users.[34]

Power Flux Density at the Surface of the Earth in the band 2025 - 2110 MHz

ITU Radio Regulations Table 21-4 limits the power flux density of transmission over a 4 kHz bandwidth between 2025-2110 MHz to the following limits.

- -154 dB(W/m^2) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane.
- -154 + 0.5 * (θ - 5) dB(W/m^2) in any 4 kHz band for angles of arrival, θ (in degrees) between 5 and 25 degrees above the horizontal plane.
- -144 dB(W/m^2) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

PFD is calculated as follows.

- PFD [dB(W/m^2 / 4 kHz] = EIRP (dBW) – 71 – 20log10(D) – 10log10(BW) – 24,

where EIRP is the Maximum EIRP of the transmission; D is the distance between the satellite and affected surface area in km; and BW is the bandwidth of the transmission in MHz

ITU-R Recommendation SA.1273 Recommends 3, limits the power flux density of transmission in any 1 MHz bandwidth between 2025-2110 MHz to the following limits for space-space

[33] *See* 47 C.F.R. § 2.106 n.US347. The 2025-2110 MHz (space-to-space) band is also allocated internationally to space operations. 47 C.F.R. § 2.106.
[34] *See* discussion *supra* page 10.

communications in the Space Research, Space Operations and Earth Exploration Satellite Services.[35]

- -130 dB(W/m^2) in any MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane.
- -130 + 0.5 * (θ - 5) dB(W/m^2) in any MHz band for angles of arrival, θ (in degrees) between 5 and 25 degrees above the horizontal plane.
- -120 dB(W/m^2) in any MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

Recommends 3.1 of ITU-R SA.1273 allows for exceeding these PFD values by up to 6 dB for no more than 5% of the time.

The PFD limits from ITU-R SA.1273 are the same as the PFD limits from Article 21 for the 2025-2110 MHz band with the small exception that ITU-R SA.1273 allows for averaging the PFD over 1 MHz of spectrum vs. 4 kHz of spectrum.[36] This is because ITU-R SA.1273 applies to Data Relay Services (DRS) which tend to be limited and infrequent emission while the FS and MS service protected by these PFD limits tend to operate with channels greater than 1MHz.[37] The nature of DRS is such that cases of simultaneous emission on tightly packed narrow-bandwidth channels are extremely rare. Coupled with the wider-bandwidth channels used by FS and MS, the 1 MHz PFD averaging bandwidth is more applicable as it provides sufficient protection to FS and MS service in the band while providing maximum flexibility for critical DRS services.

The Cornicen S-band ISL plans to demonstrate the concept of a LEO-based DRS capability. The Cornicen S-band ISL will transmit a 64 kHz carrier. While this power level could cause unacceptable levels of interference if multiple SV were transmitting (at the ITU-R SA.1273 PFD limit) in tightly-packed channels towards the same FS or MS site, the nature of DRS services is such that it would be extremely rare for any FS or MS site to receive S-band interference into the

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[35] Recommends 3 of ITU-R SA.1273 applies to space-space communications from a DRS spacecraft in GSO. However, the recommendation acknowledges that while DRS is the most common form of space-space communications in this band that other forms of space-space links are also employed. Furthermore, the scope of an interference event at a given PFD level from a GSO DRS spacecraft will typically affect far more FS sites than equivalent emissions from a LEO satellite providing a similar service.

[36] *See Allocation of Spectrum for Non-Federal Space Launch Operations, et al*., *Report and Order*, FCC 21-44, at ¶ 119 n. 261 (2021).

[37] ITU-R F.1098.

antenna main beam from more than one DRS emission at the same time. Therefore, the PFD limits from ITU-R SA.1273 are deemed most applicable for the Cornicen S-band ISL emissions.

The S-band ISL PFD is calculated as follows:

- PFD [dB(W/m^2 / MHz] = EIRP (dBW) – 71 – 20log10(D) – 10log10(BW),

where EIRP is the Maximum EIRP of the transmission; D is the distance between the satellite and affected surface area in km; and BW is the bandwidth of the transmission in MHz (rounded up to the nearest integer MHz).

Assuming the Cornicen antenna is radiating at its peak boresight EIRP towards the Maxar Satellite orthogonal to nadir, the Cornicen antenna gain for angles off boresight is used to calculate the power flux density a hypothetical ground station would receive at elevation angles ranging from 0 to 90 degrees. A diagram of spacecraft positions is below followed by a plot of the PFD versus elevation angle.

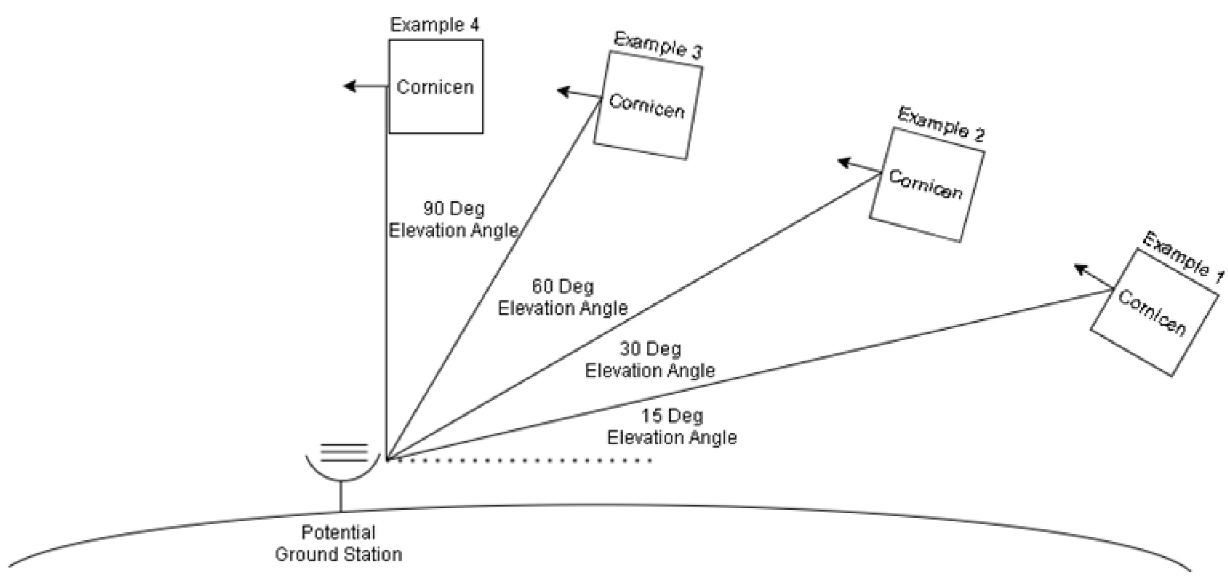

Figure 8. Spacecraft Positions

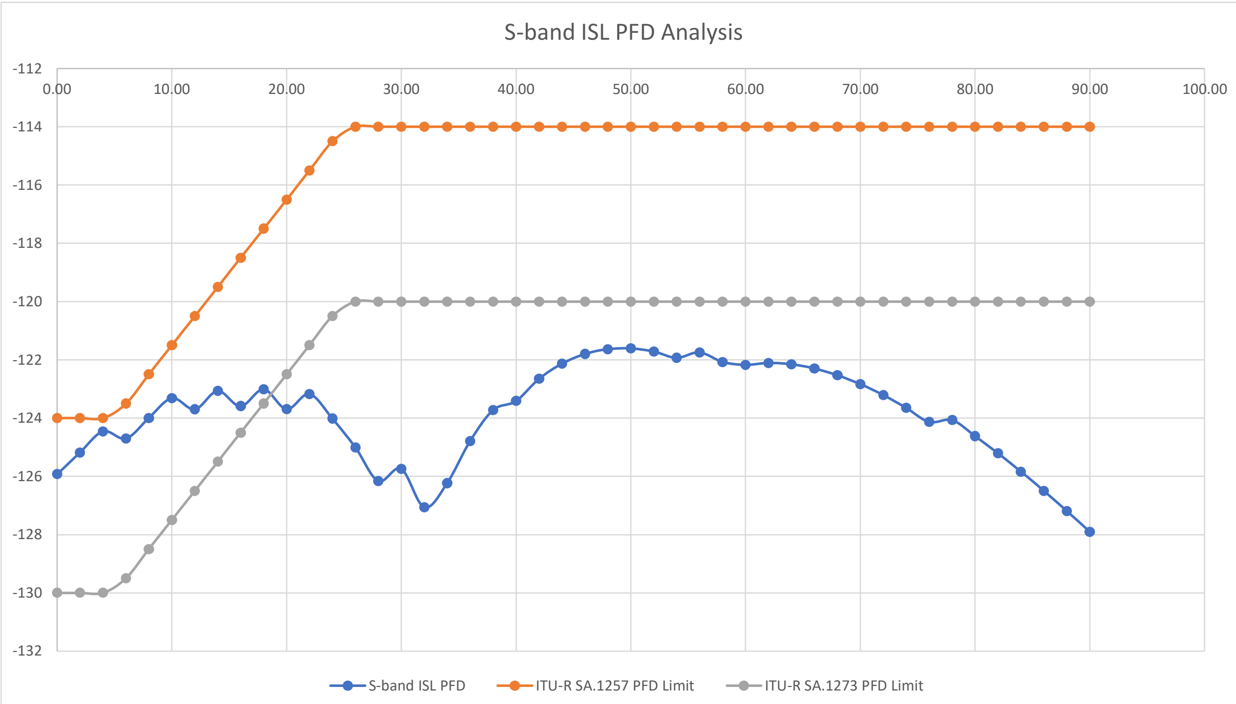

Figure 9. S-band Power Flux Density by Elevation Angle

The predicted worst-case PFD levels from the Cornicen S-band ISL slightly exceed the PFD level listed in ITU-R SA.1273 Recommends 3 for elevation angles below ~18 degrees. However, Recommends 3.1 allows for an exceedance of up to 6 dB for no more than 5% of the time.

The operational duty cycle of the Cornicen S-band ISL transmitter is not expected to exceed 5%. Furthermore, the PFD exceedances are typically far less than the allotted 6 dB and occur within only a small fraction of the satellite footprint.[38] Also, the S-band ISL transmissions will be distributed globally such that the fraction of time that any FS or MS site operating in this band would experience a PFD exceedance due to the operations of the Cornincen S-band ISL would be much less than 0.1% of the time. These infrequent PFD exceedances would translate to much less frequent interference events given that the Cornicen satellite would additionally need to fall within the main beam of the FS or MS Earth Station antenna in order to cause unacceptable levels of interference.

Potential GSO Satellite Interference

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[38] The provided PFD curve illustrates the worst-case PFD cut vs. elevation at an azimuth reflecting the direction of motion of the Cornicen satellite which aligns with the boresight of the transmitting beam.

The protection criteria for SR, SO and EESS service in the 2025-2110 MHz band, defined in ITU-R SA.1154 recommends 1.1, states that the interference at the input terminals of the spacecraft receiver, except in the case of space-space links, should not exceed -180 dBW/kHz for more than 0.1% of the time.

Analysis of the interference from the Cornicen S-band ISL emissions into TT&C uplinks at the GSO arc was conducted under a hypothetical worst-case assumption that the Cornicen antenna is radiating at its peak EIRP directly towards the GSO arc and further considers the geometry that results in the smallest distance between Cornicen and the GSO arc. In this worst-case configuration, the Cornicen S-band ISL emissions only results in -187.5 dBW/kHz of interference power density at the input terminal of a typical spacecraft receiver.

Furthermore, the S-band ISL anticipates an operational duty cycle of less than 5%. Given that this interference geometry would only occur over the poles and only when the Cornicen SSO orbit is aligned within ~30 degrees longitude of any co-frequency GSO satellite, the fraction of time that the maximum interference levels are experienced by any co-frequency GSO satellite should be less than 0.1% of the time.

Nevertheless, Hedron plans to engage in coordination with co-frequency GSO systems to evaluate their specific interference concerns and agrees to adjust the timing of planned S-band ISL contacts as necessary to assure protection criteria are met.

Potential NGSO Satellite Interference

The protection criteria for SR, SO and EESS service in the 2025-2110 MHz band, defined in ITU-R SA.1154 recommends 1.1, states that the interference at the input terminals of the spacecraft receiver, except in the case of space-space links, should not exceed -180 dBW/kHz for more than 0.1% of the time. The protection criteria for SR, SO and EESS service in the 2025-2110 MHz band, defined in ITU-R SA.1154 recommends 1.2, states that in the case of space-to-space links the interference at the input terminals of the spacecraft receiver should not exceed -184 dBW/kHz for more than 0.1% of the time.

Analysis of the interference from the Cornicen S-band ISL emissions into TT&C Earth-to-space links of other NGSO satellites was conducted. The required separation distance to avoid LoS between pairs of NGSO satellites is 4676 km if the co-frequency NGSO satellite is at an orbit altitude of 400 km up to a maximum LoS distance of 6109 km if the co-frequency NGSO satellite is at an orbit altitude of 1200 km.

The required separation distance drops to ~2500 km for geometries where the orientation of the co-frequency satellite is more than 90-degrees off boresight (e.g., the direction of motion of the Cornicen satellite). Furthermore, interference into co-frequency NGSO satellite is typically only a concern when the co-frequency NGSO satellite is within LoS of a serving GW ES. However, in the case of NGSO satellites that are co-frequency and served by a DRS satellite (such as

TDRSS), S-band ISL emissions must be suppressed any time that Cornicen is within a range/geometry that would cause excessive interference.

Hedron plans to engage in coordination with co-frequency NGSO operators to evaluate interference concerns and schedule the timing of planned S-band ISL contacts as necessary to assure protection criteria are met. Hedron plans to operate the ISL less than 5% of the time. Since Cornicen and the Maxar Legion satellite will be formation flying, ISL contacts can be scheduled any time that will not cause excessive interference. To further support the potential for coordination solutions, Hedron conducted simulations with some example co-frequency NGSO systems to demonstrate that after accounting for times when S-band ISL links cannot be established due to interference concerns, enough contact opportunities will still exist to assure mission success.

ITU filings were analyzed to find representative co-frequency NGSO systems.[39] For this analysis, NGSO systems were selected that identify specific spectrum utilization in the S-band with a spectrum overlap. The two filings identified and employed for spectrum sharing studies are LESSONIA and USASAT-30A (which is the Maxar Legion filing).

The LESSONIA filing only includes one “Specific”[40] GW ES in Brasilia but also include some “Typical” GW ES. In order to be extremely conservative, the assumption was employed to also include fourteen (14) GW ES locations from the KSAT ground network. The LESSONIA constellation consists of two SSO satellites in the same plane at a 550 km orbit altitude.

The USASAT-30A filing only included Typical GW ES. Therefore, the same set of fourteen (14) GW ES locations from the KSAT ground network were employed for demonstration purposes. The Maxar constellation consists of fifteen (15) satellites (a mix of SSO and mid-latitude orbits), in thirteen (13) unique orbital planes at orbit altitudes ranging from ~525 km to ~775 km.

Spectrum sharing simulations were conducted for LESSONIA-only and LESSONIA and USASAT-30A combined. Results are shown in the following table. As can be seen from these spectrum sharing results, while avoiding interference into other co-frequency NGSO systems will reduce S-band ISL communication opportunities, there are still plenty of remaining communication opportunities to meet the operational needs of this Cornicen mission.

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[39] Many ITU filings identify use of the entire S-band frequency band. As an operational matter, Hedron understands that such systems, if operational, do not in fact use the entire frequency band.

[40] With ITU Filings, Associated Earth Stations are considered “Specific” (AP4 C.10.b.2) if they define a precise latitude and longitude of the Earth Station. Otherwise, if the location of the Earth Station is not yet known, a “Typical Earth Station” is provided with representative RF parameters but not a physical location.

Sharing Scenario	% Time Available
LESSONIA	94.8%
LESSONIA plus USASAT-30A	82.7%

Hedron will coordinate with authorized Federal and non-Federal operators to ensure Hedron's S-band ISL operations do not cause harmful interference. Hedron has already initiated coordination with Maxar and intends to leverage this first coordination to gain insight into the scope of coordination that will be required based upon the administrations and NGSO/GSO systems that Maxar coordinated with given the common usage of S-band channels.

VIII. L-Band Intersatellite Link

The L-band IDRS provides low-bandwidth, duplex, on-demand communications via Inmarsat's geostationary satellite system. The use of this system is to assist in bidirectionally relaying Maxar Satellite data and Maxar Satellite commands. Cornicen will retransmit the data received from the Maxar satellite in X-band (8380 MHz) via L-band intersatellite transmissions and will retransmit the commands received from the L-band intersatellite link to the Maxar Satellite in S-band (2085.6875 MHz).

Direction	Frequency (MHz)	Bandwidth (MHz)	Max EIRP (dBW)	Modulation
space-to-space (Tx)	1626.5-1645.5 1646.5-1660.5	0.2	11.2	QPSK
space-to-space (Rx)	1525-1544 1545-1559	0.2	~	QPSK

Table 9. L-Band ISL Communications Parameters

Interference considerations in the 1525-1559 MHz and 1626.5-1660 MHz bands

Transmission on a non-conforming basis in the 1525-1559 MHz and 1626.5-1660 MHz bands will occur only on frequencies that Inmarsat assigns to the spaceborne Inmarsat Broadband Global Access Network ("BGAN") terminal onboard Cornicen. These transmissions are approved and supported by Inmarsat and fall within its licensed spectrum. As with its other operations, Inmarsat will assign channels to Cornicen consistent with its coordination agreements with other operators in the band, ensuring that there is no harmful interference between these systems. Inmarsat through its Network Operations Center in London and its network of land earth stations ("LES") will maintain the same extent of positive control of Hedron's operations as it does for its other L-band users and will thereby be able to address any unlikely interference issues as required by Section 25.287 of the Commission's Rules.

Because Inmarsat actively controls transmissions using this terminal, Inmarsat will be able to ensure compliance with the priority and preemption requirements specified in 47 C.F.R § 25.287(a), as follows:

(1) Inmarsat assigns a priority to the terminal, which preserves the priority and preemptive access given to maritime distress and safety communications sharing the band.
(2) This requirement is not applicable. The Cornicen terminal does not handle maritime distress and safety communications.
(3) The Cornicen terminal is assigned a unique identification number, which is encoded in the transmitted message.
(4) The Cornicen terminal is under the control of the Inmarsat land earth stations and obtains all channel assignments from such LES.
(5) At the end of a transmission, the Cornicen terminal is listening for forward link messages.
(6) The Cornicen terminal is capable of automatically inhibiting its transmissions if not correctly receiving separate signaling channel or signaling within the communications channel from the Inmarsat LES, and will inhibit its transmissions upon failure to receive such signaling.
(7) The Cornicen terminal is fully capable of automatically inhibiting its transmissions on all channels upon receipt of a channel shut-off command from the Inmarsat LES and will inhibit its transmissions upon receipt of such a command.
(8) This requirement is not applicable. The Cornicen terminal does not handle maritime distress and safety communications.

A letter of support for these operations from Inmarsat is attached as Attachment E to this filing.

IX. Optical Communications

Hedron is developing an optical intersatellite transceiver to increase data ingestion rates into the network and improve data downlinking rates to the ground. The system is primarily designed for ISL optical communications; however, an optical ground terminal will be used for the Cornicen experimental mission due to the lack of in-space link partners. The satellite will coarsely track a ground station with optical beacon. Testing will begin at angles of elevation of 20 degrees or higher and will last 10 minutes in duration on average. In the future, Hedron may seek FCC authority, as necessary, to conduct intersatellite link transmissions with other satellites.